

Licensing Requirements
for
Evaluation and Acceptance of Licensee Requests for the Disposal of Materials with
Extremely Low Levels of Contamination in Class I (Subtitle D) Landfills

This replaces the 2001 White Paper “Evaluation and Acceptance of Licensee Requests for the Disposal of Materials with Extremely Low Levels of Contamination in Class D Landfills”.

The licensee shall describe the operation of the requested landfill including but not limited to truck monitoring, waste dumping, working face operations, equipment maintenance, leachate collection, etc. The description should allow the reviewer to have a complete understanding of the daily operation of the site focusing on handling the conditionally disposed wastes. Each landfill submission shall be reviewed annually by the licensee to identify any changes that would require modification of the current license authorization and the technical basis on which it was submitted. The results of this review shall be submitted to the Division within thirty days of the review along with any licensing changes that are required to bring the licensee into compliance with the annual dose limit. Changes that might increase the approved concentration limits or the annual mass disposal limits may also be submitted provided the changes are expected to last through the following year.

Landfill Analysis Requirements

For each radionuclide and concentration requested, perform and submit an analysis verifying that the dose, to the maximally exposed individual, will not exceed 1 millirem per year (mrem/yr) total effective dose equivalent (TEDE). A separate analysis shall be submitted for each operation identified above and shall include the delivery driver, landfill workers affected and post landfill use, as outlined below, using the most current RESRAD computer code. For each analysis, use the entire useable disposal area of the landfill beginning when the conditional disposal program started.

Use site-specific data for each parameter to the maximum extent possible and provide supporting documentation and/or the justification for each choice. For parameters where site-specific data cannot be obtained and data comes from other sources (e.g., from the literature), provide supporting documentation and justify your reason for choosing the particular parameter value. For clarity on using and justifying site specific parameters refer to NUREG-1757, Vol. 2, Rev 1.

Site-specific parameter values may vary markedly within a single landfill (e.g., zone thickness, media characteristics, and distribution factors (k_d) for different soil types). Those that are conservative for one radionuclide and pathway may not be conservative for other radionuclides and pathways. It may be necessary to run separate analyses on each radionuclide to determine the sensitivity to each parameter value or group of parameter values.

For each specific analysis noted above use the following guidelines:

1. Run each operational scenario outlined above using the RESRAD computer code and appropriate input parameter values and demonstrate that the dose for each operation will not exceed 1 mrem/yr TEDE. At a minimum, the external, inhalation, and soil pathways shall be analyzed and it shall be assumed that working face employees are on the landfill 25% of the year. Each parameter value shall be reasonable and verifiable by the landfill operator.
2. Run the resident farmer scenario, using the RESRAD computer code and appropriate input parameter values, with no cover, all pathways on, and show that the dose will not exceed 1 mrem/yr (TEDE) from 20 years post closure to 1000 years post closure. Consideration for child and infant doses should be made where appropriate.

The contribution from radon from technologically enhanced waste materials shall be included in all calculations where the possibility of radon exposure exists.

Unless the most restrictive value for each parameter over the entire useable area of the landfill is chosen in the analysis submitted, a new analysis will be required for each new phase of the landfill.

The Department may use the RESRAD probabilistic sensitivity and dose analysis for any parameters that cannot be documented and justified. Concentrations determined by this process will be used in the approval for a specific landfill. For guidance on the use of RESRAD probabilistic analysis, refer to the Yankee Rowe license termination plan submittal which can be found at the Yankee Rowe Site Closure website.

DRH will perform an analysis of possible leachate concentrations based on waste concentration limits, the area of the disposal site, and appropriate site parameters. These leachate concentration values may in some cases be limiting on the waste concentrations which may be approved.

The most restrictive individual radionuclide concentration as determined above will be authorized for each landfill.

General Requirements

1. The radiation level at the surface of any conditionally disposed container shall not exceed 50 microrem/hr (uR/hr) at each surface and 10 uR/hr at 1 meter from each surface including the top and bottom of the container.
2. Each approval for a specific licensee is only for the area of the landfill approved for disposal by Solid Waste Management permit at the time of the request. Each licensee must submit an independent analysis for a requested landfill using the most current engineering geotechnical and hydrological data available and supply the supporting documentation for the data. Updated parameter values for an area of the landfill

subsequently approved by Solid Waste Management must be submitted to re-evaluate the approved limits of an earlier authorization.

3. A sum of the fractions¹ rule shall be applied to mixtures of radionuclides in waste materials in each conveyance such that the total of all fractions does not exceed 1 and where the effective limit results in calculated doses that do not exceed 1 mrem/yr TEDE. For radionuclides listed as being in the waste stream but not detected, the LLD values shall be included in the sum of the fractions calculation.
4. Intentional mixing of high and low density materials for purposes of reducing the radionuclide concentration of the waste is prohibited.
5. The intentional mixing of waste materials containing radionuclide concentrations above the conditional disposal limits with either clean materials or waste materials containing radionuclide concentrations below the conditional disposal limits, for the purpose of reducing the radionuclide concentration, is prohibited.
6. Materials evaluated for conditional disposal must be analyzed in a container no larger than that in which they are received. Aggregation of containers or placing of smaller containers in larger ones for analysis is prohibited. Containers which initially fail the analysis may only be passed following re-analysis if the waste material which caused the failure has been identified and removed for separate disposition.
7. Waste materials which are readily dispersible in air during landfill operations, and for which inhalation/ingestion is the controlling dose pathway, shall not be considered candidate materials for this disposal program.
8. The annual mass allowed for disposal at each landfill shall be limited by license condition for each licensee. The mass limit will be calculated by DRH based on the average of the total mass disposed at the landfill in the 3 years preceding the most recent completed year. (e.g. average of 2004, 2005, and 2006 for 2008). The total mass approved for conditional disposal will not exceed 5% of the three-year average disposed at the landfill.
9. If multiple licensees request authorization to utilize a specific landfill, and if the requested disposal masses would exceed 5% of the three-year average of mass disposed, each licensee's disposal mass authorization may be adjusted by the Division.

¹ Sum of the fractions rule: If radionuclides A, B, and C are present at concentrations *concA*, *concB*, and *concC*, and their respective limits are *lim A*, *lim B*, and *lim C*, then the following must be true:

$$\frac{concA}{lim A} + \frac{concB}{lim B} + \frac{concC}{lim C} \leq 1$$

10. In determining the mass of conditionally disposed waste for purposes of General Requirement #8, an adjusted mass total may be determined by multiplying the actual mass of each package of waste by the dose fraction (dF) for that package calculated in General Requirement #3 and Footnote 1. The annual adjusted mass sent to the landfill by the licensee would be the sum of all adjusted waste package masses. Waste packages with measured concentrations greater than the licensed disposal concentration limit are not eligible for this adjustment and shall not be disposed in a Tennessee landfill, except as provided in General Requirement #6.
11. The licensee shall submit a report of its conditionally disposed waste to the Division within 30 days of the end of each calendar quarter. The report shall include, for each landfill authorized, the total amount of waste mass in pounds (actual and adjusted), the radionuclides in each conveyance, the concentration in pCi/g of each radionuclide in each conveyance sent to a landfill, the corresponding total pCi of each radionuclide, and the fraction of the annual mass limit used to date.
12. For conditionally disposed waste shipments the licensee shall submit a report within 30 days of the end of each calendar quarter listing any rejected shipments, including shipments rejected for setting off radiation gate alarms at landfills.
13. Sealed sources shall not be acceptable for inclusion in materials considered for conditional disposal.
14. Notwithstanding the radionuclide concentration limits determined by RESRAD for 1 mrem/yr dose, the licensee shall not exceed the USDOT activity concentration for exempt material values given in 49 CFR 173.436 or determined according to procedures in 49 CFR 173.433.

Waste Analysis Requirements

15. Gamma spectroscopy assay systems and techniques shall not be used as the sole assay methodology for waste materials conditionally disposed in landfills.
16. The licensee shall require from each generator a detailed isotopic and concentration analysis of the waste materials in each shipment including all hard-to-detect radionuclides. Process knowledge and generic scaling factors shall not be relied upon solely for determining scaling factors. Process knowledge may be used to assist in determining the appropriate method and scope of the analysis. Scaling factors used for alpha, beta, and low energy gamma emitters present in a waste stream (e.g. reactor wastes, university wastes, lab wastes, etc.) shall be established and documented for each specific waste stream. Scaling factors shall be determined using an appropriate laboratory methodology (e.g., methodology established by NCRP, ANSI, or the NRC) and performed at least annually. Documentation shall include the equivalent of a uniform radioactive waste manifest (inbound to the processor), with all radionuclide and waste form data provided.

17. For each conveyance to a landfill, where scaling factors are utilized, documentation referencing the waste containers in the conveyance to the appropriate lab analysis (and QC analysis where applicable) must be maintained.
18. Waste stream analysis shall include quantification of radionuclides that exceed 0.1% of waste mixtures. All licensed radionuclides present at >0.1% (by activity) of any waste mixture shall be included in deriving pass/fail limits for conditionally disposed waste. Delisting of radionuclides in accordance with otherwise applicable guidance shall not be applied to the assay program.
19. Each licensee shall be able to demonstrate by measurement or calculation that the assay and laboratory methodologies utilized are able to detect the levels necessary to show compliance with the disposal limit for each radionuclide. The lower limit of detection for assays shall be at the 95% confidence level.
20. The licensee shall determine that the waste material is essentially homogeneous, and sampling shall be sufficient to demonstrate that the scaling factors are consistent throughout the volume of waste. The assay data used for comparison with the derived sum of the fractions limit (including scaled radionuclides) shall be the average of at least three assay measurements. Each individual assay measurement shall be within a factor of three times the average limit to ensure homogeneity.
21. A quantitative gamma spectrometry assay measurement shall be performed of each 400 ft³ of waste materials, using appropriate calibration factors, including geometry and density factors. The analysis shall be sufficient to achieve an LLD equivalent to or less than 10% of the conditional disposal limit for each radionuclide used as a basis for the application of factors to that waste stream. If a given radionuclide LLD cannot be shown to be 10% or less of the applicable limit, then waste activity must be assumed to be present at the LLD value.
22. A representative QC sample shall be collected from each waste stream, when shipped in large containers (e.g., intermodals). Samples shall be counted to achieve an LLD equivalent to 10% of the conditional disposal limit for each radionuclide used as a basis for the application of scaling factors to that waste stream. If a given radionuclide LLD cannot be shown to be 10% or less of the applicable limit, then waste activity must be assumed to be present at the LLD value.
23. Any waste lacking a gamma component shall have an assay measurement performed of each 400 ft³ of waste materials. The assay shall be sufficient to achieve an LLD equivalent to or less than 10% of the conditional disposal limit for each radionuclide used as a basis for the application of scaling factors to that waste stream. If a given radionuclide LLD cannot be shown to be 10% or less of the applicable limit, then waste activity must be assumed to be present at the LLD value.